IMPLEMENTATION OF RISK INFORMATION INTO THE DoD DECISION MAKING STRUCTURE

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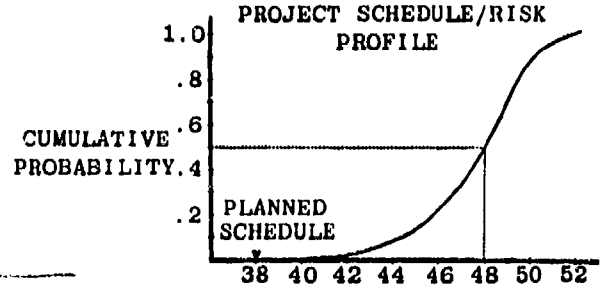
The time has arrived for accurately predicting programmatic cost and schedule risk on large weapon system projects. Management science and operations research techniques coupled to power of today's computer provide timely decision information for sophisticated budgetary and scheduling strategies. However, the time for using this information in a systematic fashion has not arrived.

This document discusses the problem.

Some years ago, I was working on the cost/schedule budgets and risks for a major weapon system development. I was suddenly summoned by the newly appointed Project Manager. Upon arrival he promptly asked "Mr. Cockerham, what is the probability that I will bring this program in on schedule?" With surgical precision, I replied "Zero, Sir." He asked "What is the probability that I will bring this project in within costs?" Again, my reply, "Zero, Sir." He raised his voice and asked "Well then, what is the good news?" I answered, "That was the good news!" In looking back at the exchange, the Project Manager was just trying to learn something about his program risks and I was of the mind set to simply answer the question and no more. This was a rather meaningless exchange in that probability alone did not indicate the risks nor help the Project Manager better understand his program.

To illustrate the point a risk profile for the schedule of project is shown on Figure 1.

FIGURE 1



An Appropriate Statement of Risk:

"There is a (.5) probability that the program will take up to ten (10) months additional time to complete than planned."

This does not mean that the Planned Schedule should be rescheduled to forty eight (48) months. On the contrary, the thirty eight (38) month Planned Schedule is used to drive the program to the earliest possible conclusion. This strategy, in fact, serves a useful purpose but unfortunately, total program dollars are often tied to a zero probability schedule which of course yields a zero probability budget. Such is just one of the numerous examples of the difficulties in communicating with probabilistic information. Even when these difficulties are overcome at the program level, the Project Manager is, at best, reluctant to communicate this information to higher levels. This can be easily understood when one looks at some of the type information yielded from a probabilistic analysis. The following examples are true statements concerning some <u>well planned programs</u>.

"Probability of meeting the schedule is zero."

"Probability of meeting the planned cost is zero."

"Incremental funding of some long lead items for production should be initiated prior to the development program."

"$100M of RDT&E funding is needed for the planned program two years after the IOC."

"There are negative cost risk in the middle years of the Engineering Development."

"The cost risk is greater than the planned project budget."

Although there are inherent difficulties in communicating risk information, the primary difficulties in DoD are presented by a system of compartmental decision making that is steeped in tradition, power structures and resistance to change. Although frustrating at times, it is recognized that the aspects of our system that give reasons to problems, also give reasons to much success. Nevertheless, there are substantial problems in implementing risk information to the DoD decision making process.

The problem begins at the Congressional level in that there are no requirements for uncertainty or risk information to support the Congressional responsibility of deciding which programs are funded and how much. Moreover, the Congressional decisions are intertwined with the political process which customarily yields compromised results. Such decisions are largely based upon qualitative assessments and political values. There are no management science or operation research methods to describe the Congressional process. However, it is my contention that it is better to know the program's planned cost and risks than to know only the program's planned cost.

At DoD there has been no shortage of words written and words spoken to the need to analyze, plan and budget for program uncertainties. Lacking in these words are firm instructions, guidance, requirements and the propensity to use the information.

The Defense Acquisition Initiatives have stimulated some thinking and action by the Services. However, the action has been tenative and lacking in application. This is understandable in that there is no coordinated push from DoD, nor has Congress expressed any approval, disapproval or even knowledge of the efforts to budget and plan for risk. Congress is hardly to blame since there has been no DoD spokesman on the subject and service projects mask the risk cost in their budgetary submissions to Congress.

The following discussion addresses the Lessons Learned concerning the Implementation of the TRACE Concept for the Navy. The lessons learned are based on experience from the Army's TRACE program and the Navy's experience since September 30, 1981. The information was generated by this author under a contractual effort for the Pilot Application of the TRACE Concept for the Navy, February, 1983. The lessons are generally applicable to DoD interest and are categorized by the following areas:

Navy TRACE Implementation Lessons Learned

* Fiscal Management
* Training/Education
* Manpower
* Methodology
* Application
* Project Management
* Resources

The nature of the lesson is described as an observation with support rationale and followed by recommendations. The subject areas are addressed independently but are in fact interrelated. Therefore, the acceptance/rejection of the observations and recommendations should also be viewed collectively.

Fiscal Management

Observation:

The Navy has not developed the fiscal management methods to systematically incorporate the elements of the TRACE concept. There is confusion and doubt on behalf of Project Managers on how to prepare budgetary submissions with the Risk Cost Estimate (RCE) and what adverse effect may result when compared to previous budgetary submissions.

Support:

The Army developed a management system in conjunction with the methodology of the TRACE concept. The management system described the

who, what, when and how the Army RDT&E monies would be managed. Organizational infighting and confusion were completely avoided. Though the Army system has some shortcomings, the TRACE concept has survived largely due to a comprehensive management system from the onset. The Navy's approach has been overly cautious to not make changes until there is certainty that the TRACE deferral monies will not be rejected by Congress. The Army has already provided the lesson that Congress will not remove the TRACE deferral monies when properly presented. However, the Navy has not determined the method of presentation nor the means for managing the money thereafter. Navy policy on these matters should not be mutative and chance failure at each level of budgetary review. Instead the lesson learned by the Army should be heeded and Navy policy established accordingly to Navy needs.

Recommendation:

Immediate action should be taken to establish the Navy's management system of RDT&E and production TRACE deferral funds. This effort should include how the funds are established, updated, processed, authorized, expended and tracked.

Training/Education

Observation:

Training and education at all levels in the Navy is currently needed.

Support:

The lessons learned by the Army were:

1. TRACE was initially successful due to a comprehensive educational and training program. Congressmen, Senators, professional staffers, and top management at DoD, DA and DARCOM were given 15-20 minute individual presentations on the concept. Every Commanding General, Deputy Commander, Project Manager and Deputy Project Manager was individually given a 20-30 minute briefing. Management staffers at all levels were briefed in groups of twenty (20) or less for approximately one hour. Cost and system analysts were given two (2) day courses. All training was provided by the same training team to insure consistent and exacting information.

2. As TRACE was initially successful on a short term basis due to the educational program, TRACE was equally unsuccessful on a long term basis due to a major extent, to the lack of follow-on training.

Recommendation:

The Navy should initiate an intensive training and educational program to introduce the science and management methods associated with the TRACE concept. This short term training should be coordinated with a Navy handbook and be similar in scope to the Army's initial training program. The training should be accomplished in no more than six months at a cost of less than $100K. Subsequent to the initial training, a plan should be developed for a long term in-house training capability. This could be incorporated into the mission of Navy or DoD schools.

Manpower

Observation:

Currently, no significant manpower capability has been manifested within any service to apply the scientific methodology supporting the TRACE concept.

Support:

From Army, Navy and major contractor experience there is no organization or job function or job code that can readily be used to perform TRACE type analyses. The problem is independent of any lack of training or education on the subject. The problem can be visualized in that virtually all organizations are divided functionally in elements, (i.e., cost, schedule, program plans, program management, test, logistics, quality assurance, procurement, personnel, etc.). However, a TRACE analysis requires that detailed analysis be performed across all elements as relates to cost, schedule

and uncertainties. Furthermore, all elements are modeled and analyzed together. This is all possible due to the advancements in computer hardware/software technology. However, traditional organizational elements are not structured to take advantage of computer technology promoting integrated analysis and decision making.

Recommendation:

On a trial basis with a lead command, the Navy should detail a group of four to six individuals to do acquisition planning. This group of acquisition planners would work on multiple projects and cut across functional boundaries. Within six to twelve months a credible and useful in-house capability for acquisition planning and TRACE analyses could be established.

Methodology

Observation:

Methodologies in support of probabilistic analysis for the TRACE concept have not been established by the Navy.

Support:

For the analysis and distribution of TRACE deferral RDT&E monies the Navy has used an interactive network analyzer known as RISNET and methods of risk enumeration. These have been accomplished on a contractual basis and the Navy has not taken steps to endorse nor establish an in-house capability. Having the methodology in-house is the most essential part of establishing a capability. The computer hardware/software and operator's instructions must be made available and accessible for any significant utilization.

For TRACE production, there has been no effective methodology developed by any Service. The areas of production cost, cost overruns and production risks are matters of great national concern, regularly voiced through the Congress and the news media. However, there is no concerted effort to develop the methodology to accurately predict production costs and cost risk.

In summary, the RDT&E methodology exists and is available to the Navy. The production methodology does not exist.

Recommendations:

1. The Navy acquire the hardware/software for RDT&E TRACE analysis and make it available to all commands.

2. The Navy initiate an applied research program on production cost risk analysis for a ship, aircraft, and missile system.

Application

Observation:

The planned applications for Navy projects are insufficient to support the implementation of the TRACE concept.

Support:

The Carlucci initiative requires the services to implement TRACE or a TRACE type system. The explicit implication is that the TRACE concept is to be applied to all projects at all commands. The Navy has initially had good experience in applying the methodology, but only at one command and on one project. Application to programs must be significantly increased if the implementation of the TRACE concept is to be a serious consideration.

Recommendations:

1. Building on the NAVAIR experience, the S-3B application should be continued in order to demonstrate the maintenance of the technology and usefulness on a continuing basis. In addition, two new applications should be initiated. The projects should be selected based on a need for detailed planning and costing. If possible, the projects should be of high complexity and early in the conceptual or development phase.

2. In conjunction with lessons learned in Training/Education, Methodology, Manpower and Application, the technical

responsibility for the application of the TRACE methodology should be identified within NAVAIR.

3. One application of probabilistic network analysis should be initiated for an R&D program at each Navy command.

4. One application of TRACE for production (TRACE-P) should be initiated for a lead command. This would be an applied research effort and should be performed on a pilot project for lessons learned.

Project Management

Observations: S-3B Experience

1. S-3B Project experience with complete RISNET analysis was judged favorable and cost effective.

2. S-3B PMA used the network model as a vehicle of communication with the prime contractor to baseline the program (i.e. program logic, milestones, deliverables, critical path, costs, and uncertainties). The network continues to provide a framework for programmatic communication between the PMA, Lockheed, NADC, and JMCA.

3. The prime contractor used the network to better define the activities and interrelationships of the program. The prime contractor was receptive and helpful in the application of the RISNET methodology.

4. The S-3B PMA used the network model and RISNET data to successfully defend the project's baseline budgets and schedules.

Support:

The TRACE budget determination is just one by-product of interactive network analysis. The value to the Project Manager encompasses all aspects of the TRACE methodology to include:

Master Network Display
Sub-network Display
Schedules
  * Barcharting
  * Milestone/Deliverables
  * Critical and Near Critical Paths
  * Uncertainties/Risks
  * Tracking and Control
Costs
  * Baseline Costing by Fiscal Year
  * Cost Risks by Fiscal Year
  * Budget Allocating
  * Multiple Cost Functions
Joint Cost and Schedule Analysis
Alternatives and Trade-off Analysis

Recommendation:

The Navy should expand applications of the TRACE methodology for Project Managers. (See Application Recommendations).

Resources

Observation:

Insignificant resources have been committed to the application of the science embodying the TRACE concept.

Support:

Between 1972 and 1977 the Army spent $14,000 for the TRACE Guidelines. In 1978, $200,000 was used to purchase RISNET software and training for all Army RDT&E commands. Since 1981, Army in-house expenditures are estimated at $200,000 for the purpose of establishing a methodology for analyzing production cost uncertainties. Since the Carlucci Memorandum in April 1981, Navy expenditures total approximately $200,000. All resources expended on methodology and training is equivalent to approximately 5-6 man years since 1972. This is less than one-half man per year for a concept credited to save millions of dollars. Each year the Government spends tens of millions of dollars on conferences, seminars, and symposiums to address the problem of cost estimating for weapon systems. Yet, the most promising field of cost planning, predicting and budgeting receives virtually no funding year after year. TRACE methodology is at

the leading edge of the computer aided decision sciences and should be pursued aggressively.

Recommendations:

1. DoD, through a lead Service, should commit a minimum of five million dollars in FY84/85 for the specific advancement of TRACE methodology for RDT&E and production; procurement of computer hardware and software; and education at all levels.

2. DoD, through a lead Service Command, should initiate a study to define a physical facility of computers, visual screens, graphic terminals, plotters, communication equipment and software that would provide state of the art planning, costing and control of programs. The system definition should address the schedule and resource requirements for the facility, security, computer hardware, data base and operational software, documentation, training, implementation and cost for duplicate facilities.

Many problems face the practical implementation of risk information into the decision process. However, the last year has produced greater progress than all previous years. Request for proposals are requiring risk information and in at least one case, cost realism was evaluated equal to the total cost. DoD top management, on several occasions, has mentioned the TRACE concept to Congress in testimony regarding the improvements to the acquisition process. Prime contractors are using risk methodology to enhance their proposals and risk management methods to better control their projects. At least one of the services is actively reviewing selected programs explicitly for cost risk. Most significantly, the reviews are conducted by the Office of the Under Secretary.

Heretofore, the exclusion of formal risk information in the decision process has been the greatest shortfall in DoD and Congressional planning. Changes have begun and are inevitable because the knowledge of risk has been proven not only useful but absolutely necessary.